North Fire
Unmanned Aircraft Systems
Testing & Evaluation
After Action Review

June, 2016

Cibola National Forest

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Executive Summary

In late 2014, an interagency agreement to work towards integrating Unmanned Aircraft Systems (UAS) into the wildland fire mission was signed by the Forest Service and Department of Interior (DOI). The 2015 fire season saw three different testing and evaluation (T&E) missions using a demonstration contract with commercial service providers.

In June 2016, the North Fire on the Cibola National Forest was being managed for long term resource benefits. Both the Forest and Incident Management Team, saw a T&E opportunity for UAS in a lower risk fire setting. Discussions began with the UAS Program Managers for the Forest Service and Bureau of Land Management (BLM).

The BLM provided three of the four module members and several fleet aircraft. The fourth module member was provided by the DOI UAS Branch. The aircraft flown were a fixed-wing Falcon and a 3DR Solo quadcopter.

The Incident Management team (IMT) worked with the module for several days in two main configurations. The Falcon flew infrared imagery where the data was sent off overnight to an agency data processor. Maps and data products were developed and provided the next day. The Solo was used directly with ground crews to provide real time situational awareness.

The North Fire T&E mission was the first time the Forest Service hosted small UAS on fires flown by government fire agencies using fleet aircraft. It was also the first time the BLM module had flown UAS in the fire mission. The North Fire T&E helped identify gaps in the way aviation resources are dispatched, mobilized, utilized and operated in regards to unmanned aircraft and wildland fire management.

The Falcon demonstrated strengths which are more suited towards projects where time constraints are not limiting as with fire activity. Agency data processing capability will need to be expanded to accommodate the volume of workload associated with fire data products. The Solo showed value in the real time situational awareness model working with ground crews.

In general, the T&E progressed as expected with time spent becoming familiar with the capabilities of a new aircraft type and figuring out how to work it into fire management operations. Specifically, the T&E mission on the North Fire highlighted a strong need for an operational guide, standard operating procedures and more T&E opportunities.

The IMT, Cibola and Region 3 should be commended for their willingness to host the T&E mission on the North Fire.

Stakeholder Discussion

After the operational flights ended on site at the North Fire, two conference calls to gather feedback from stakeholders were held. Participants included personnel from the North Fire IMT, Cibola National Forest, Southwestern Regional Office, UAS module and the Forest Service Acting National UAS Program Manager.

The discussion flow followed a general format for after action reviews:

Four main ideas were focused on-

- ~ What went well?
- ~ What could have gone better?
- ~ What surprised you?
- ~ What changes would you suggest for the future?

The complete fire assignment process with those four ideas in mind was discussed-

- Planning
- Ordering and dispatching
- In briefing- Forest and Incident
- Flight Operations
- Debriefing and demob

Additionally, if it hadn't already been discussed,

- Data management and products delivered
- Key considerations for unmanned aircraft
- Ideas of future UAS utilization in fire management
- How PASP and UAS Project Request form fit actual operations.
- Open Bin items

The following bullet items are taken directly from the discussion. Some items may conflict as everyone had a chance to provide input and all perspectives are noted.

Planning

- The Project Aviation Safety Plan (PASP) was written and approved within 24 hours. A National standard template will be developed using the North Fire PASP as a basis.
- Building a PASP for fire use is inefficient and could be mitigated by an Interagency UAS Fire Operations Guide.
- The UAS Project Request Form was useful to begin the discussion and ordering decision, but the form information was not used after the initial decision to place the order.
- The FAO had good communication about the process. It took two weeks, but the forest and fire understood the process.
- The fire understood the intent for testing and evaluation and was willing to be exploratory in what the UAS module could provide.
- The Regional Office was not clear on the intended outcome and would have liked more specifics.

Ordering and Dispatching

- Having THSP on the UAS module personnel's redcard would be a benefit to rapid ordering. It took some effort to get the four UAS module members set up in ROSS. They are now set up for future dispatches.

- The original order was for the three field personnel. The crucial fourth person to process data had to be approved by the fire separately. Establishing the module as four persons with the potential for one or more to remain off site will be beneficial in the future.
- Consider mobilization times and incident need. Shipping equipment to the incident and commercial air travel for the personnel to mobilize quicker.
- The ROSS ordering system is not set up for UAS resources as there is currently no way to account for the aircraft itself. The personnel were ordered and the UAS were noted in special needs/equipment.
- It was identified that IQCS qualifications and NWCG training as well as how to account for the aircraft in ROSS will need to be developed as UAS fire integration proceeds.

In-Briefing – Forest and Incident

- The Forest aviation resource in-briefing was well organized and thorough. The Forest Aviation Officer created an outline that could be used as a standard for future briefings.
- The FAO set up a time for the Regional Office and Forest personnel to interact with the UAS module, receive a briefing and ask questions. Personnel in attendance appreciated the extra effort at interfacing with the UAS and module.
- The Incident provided a good briefing of fire area specifics. The Module felt they received the information they needed to begin operations safely.
- One item to ensure is clear to all involved is who the UAS Module works for. There was no issues for the North Fire, but the larger interagency community will need guidance to set the standard, so it isn't different every time.
- The UAS Module attended an IMT planning meeting early on which was valuable from their perspective.
- UAS Module attendance and discussion at the evening briefing was also identified by the incident as positive.
- The UAS Module attended the helibase briefings which facilitated communication between aviation resources.
- The need to brief with aerial supervisors was identified although it was not applicable for the North Fire.
- The fire in-brief really started the discussion on how best to integrate the UAS with the incident resources. Which is different from established resources.
- As the fire was active and resources were engaged, the Incident Commander (IC) and Operations Section Chief (OSC3) did not have much time to fully brief the UAS module.
- The Regional Office had expected an in-brief prior to the UAS module going out to the fire as this is a new resource, but one did not occur.
- It was identified that as UAS is just now beginning to integrate a more extensive in-briefing and wider opportunity for awareness should be provided.

Flight Operations

- There was good coordination with the helicopter pilots and OSC3 to establish separation procedures and mission priorities.
- There was good direct communication with the helicopter crew to coordinate missions in the Fire Traffic Area (FTA).
- The protocol established in the PASP held that either manned or unmanned were airborne at the same time when no aerial supervisor was present. This led to inefficiencies which should be looked at for future operations. National standards for situations where manned and unmanned could both be airborne at the same time depending on risk, should be a goal. *NOTE- The PASP addresses adequate separation and does not state one aircraft type or the other. The need for understanding of how the UAS and manned aircraft would operate is highlighted by this statement.

- The UAS Module worked for the OSC3 who at times was busy. An Aerial Supervisor coordinating aviation resources might have alleviated delays. A National standard or protocol should be evaluated as mentioned above.
- The ground control station monitors were extremely difficult to see in direct sunlight.
- The UAS Module integrated will into the traditional Incident Command System (ICS) structure via the Planning and Operations Section Chiefs.
- Familiarizing IMT personnel with the capabilities and limitations of the aircraft and data product types took time and could be seen as a distraction.
- Finding safe launch and recovery areas for the fixed wing system was a challenge.
- The current work/rest policy for UAS flight crews was difficult to manage and may not be appropriate since most of the crew's time was spent performing normal and expected incident duties (driving, briefings, hiking etc.)
- Working directly with crews to demonstrate and provide situational awareness worked very well. Firefighters would watch live video directly on a tablet as the aircraft flew over points of interest as directed.
- Hand flying the micro UAS for situational awareness takes a high degree of skill and training a broader pool of pilots will need to occur.
- The aircraft were negatively affected by GPS satellite testing conducted by the military. Two flights were delayed due to this vulnerability.
- The FAA Emergency Certificate of Authorization (eCOA) process was not implemented as advertised. There was confusion between Albuquerque ARTCC and the eCOA Office, which created a substantial workload for the DOI staff.
- The National Interagency Fire Center photographer was a distraction in the beginning. It might have been better to let the UAS module integrate with the incident a few days before trying to document the process.
- There was a bit of a challenge to figure out how to integrate the UAS into the incident operation. It took a few days to get it really going.
- The North Fire utilized the UAS under the OSC3, but could see where Planning might also be a place. As UAS integrates into the fire mission, it will have to be determined the best fit in the ICS structure.
- The Division Supervisor really liked the application of real time imagery for situational awareness. Once the UAS was tied in with crews, the benefit of the resource hit its stride.
- It was observed the UAS module had been familiar with project missions and more in line with the Planning function with no real time constraints. There were times the IMT wished the module could implement faster with the operational pace. It was also identified that the pace of UAS will get faster with familiarity and broader integration.
- The manned aircraft was not as comfortable in the beginning with the unmanned operation, but then became comfortable. It almost seemed the UAS folks flipped and became more uncomfortable working with the helicopter airborne. Airspace coordination was identified as a huge factor and needing to be developed as UAS integration continues.
- There was a communication event where the helicopter ferrying into the helibase from the airport in the early morning was not informed of the UAS being airborne. This was a courtesy communication as the UAS was flight following locally at the incident. The need for a solid radio communication plan in advance of operations was identified.
- Communication in general was an issue on the fire.
- The UAS Module was sometimes flight following locally on the fire and sometimes contacting the Forest Dispatch Office. This led to confusion on what the communication expectations were. As with any aviation resource, local flight following should be the norm.

- Although this was managed by a Type 3 Incident Team, having a dedicated person for air operations might have provided benefit as a liaison between the aviation resources and OSC3.
- The IMT was surprised by the visual line of sight limitation and short duration of flight based on battery life. They had expected more a high altitude, long duration aircraft. Understanding the limitations of the aircraft being offered is important in the future.
- It was identified a UAS Operations Plan with platform specific information would be of benefit to reducing confusion.
- The weather limitations were also a surprise to fire managers.
- The BLM was able to offer some infrared (IR) imagery, but with a time delay for data processing. Incident personnel were expecting real time information. Understanding what is being offered by each platform in the future would be beneficial.
- The ortho map scouted ahead of the burn area sounded good and was nice, but not totally useful. With a little tweaking, it could be very useful, especially if it could be real time.
- A before and after ortho map was created for documentation. That was seen as useful.
- The real benefit to the UAS testing was seeing what the micro (3DR Solo) UAS was able to produce as far as data. The ground crews found the real time imagery very useful.
- There was discussion on staying within the provisions of the eCOA and how easy it might be to go outside of what is authorized. (e.g. over private land when mapping).

Debrief and Demob

- There was a daily pre shift and post-shift phone call between the UAS Module and the OSC3. One the last operational day, the pre-shift call occurred, but there was no formal out-brief due to activity.
- The demob process went well with the IMT organization.
- Travel limitations for the UAS personnel were a surprise and needed to be taken into account. As pilots, they have more restrictive duty limitations. This should be discussed in a UAS Operations Plan so the incident understands what to expect.
- Although not a factor in the North Fire, there needs to be discussion on how to replace and damaged equipment or components. Identifying the appropriate system in the event of damage should be an emphasis as UAS become more prevalent in the fire mission.
- The Regional Office expected a debrief after the assignment, but one did not occur.

Data Management and Products

- There was good communication between the on-site module members and the fourth person processing data off-site.
- Wi-Fi connection to send data was not the most time effective method. Future operations might need to look at a SatCom contract to provide consistent, fast data connectivity.
- The offset schedule for the data processor was effective in getting the data processed for products.
- Training data processors will be a workload for the interagency community. Not a common skill set.
- The Falcon IR sensor was not as good as the Scan Eagle from last year.
- The module will send a hard drive with information after cleaning up unnecessary raw data.
- From the incident perspective, there were interagency limitations, such as needing a BLM computer to upload to the BLM servers. These will need to be worked out for full interagency integration.

Key considerations for unmanned aircraft

- The longer duration higher altitude UAS would seem more appropriate to incident support with real time data products.
- The micro UAS seem highly beneficial when imbedded with ground crews for real time situational awareness.

Future utilization

- Developing IQCS qualifications, NWCG training, ROSS protocols along with a UAS Operations Plan would provide benefit to a smother integration, reduce confusion and provide better utilization of UAS in the fire mission.

Open Bin

- Under normal operations, the Falcon lands using a parachute to reduce damage to the belly mounted sensors. On the North Fire, the Falcon landed harder than normal. The BLM module will work with the manufacturer to access the telemetry data. The BLM Module believes the elevation at the launch and recovery site affected the parachute's efficiency. A SAFECOM will be filed for documentation purposes.

Take Away Lessons

- For the first time the interagency UAS Module has been used on fire, it went as well as expected. The fire managers began to get familiar with what the platforms had to offer, and the UAS module began to get familiar with operating small UAS in the fire mission.
- The micro UAS was hugely successful in providing ground crews with real time situational awareness information.
- The duration and time lag for data processing with the Falcon was not as conducive to fire missions as it is for project mission.
- Effort needs to continue in regards to developing a Fire UAS Operations Guide; training and certification standards; ROSS updates, standard operating protocols and an understanding by fire stakeholders on the capability and limitations of UAS in the fire mission.

Project Aviation Safety Plan

PROJECT AVIATION SAFETY PLAN (PASP) Unmanned Aircraft System Evaluation North Fire Cibola National Forest			
Mission: Aerial Photography	Project Name: North Fire	Unit: NM-CIF	Fixed Wing ☐ Rotor Wing ☐ **UAS X**
Anticipated Project Date(s): Early June 2016			
Project Plan Prepared by: Gil Dustin		Title: BLM UAS Program Manager	Date: 5/31/16
Project Plan Reviewed by: /s/ Jami L. Anzalone		Title: USFS UAS Program Manager	Date: 05/31/2016
Project Plan Reviewed by: \s\ B. Rogers Warren		Title: Forest Aviation Officer(acting)	Date: 5/31/16
Project Plan Reviewed by:		Title: Regional Aviation Safety Mgr.	Date:
Project Plan Reviewed by:		Title: Regional Aviation Officer	Date:
Project Plan Approved by: Elaine Kohrman Cibola NF Forest Supervisor		**Title:** Forest Supervisor	**Date:** 6/1/2016

PROJECT DESCRIPTION/MISSION OBJECTIVES:

Compliance with the operational procedures outlined in this Project Aviation Safety Plan is required.

The objective of this mission is to test UAS and UAS sensors in the incident environment. Lessons learned from this assignment will aid the interagency community in developing operational procedures for future integration of UAS into fire/incident management operations. UAS have not been utilized in this capacity and this assignment will serve as a test of UAS and sensor capabilities.

Small UAS (Falcon or Falcon Hover) will be used to gather aerial images and video to support the operational/monitoring objectives of the North Fire. A micro UAS will be introduced to fireline personnel and tested as a crew level situational awareness tool. Falcon and Hover are owned and operated by the BLM National Aviation Office. The micro UAS is on loan to BLM from DOI OAS and has been provided to them as a test/demo platform by 3D Robotics. BLM will provide a crew of authorized UAS operators for all the aircraft.

An incident managed for resource benefit is a great opportunity to test the equipment, evaluate the data products and assess the overall value of UAS to incident personnel. Potential interagency uses of this technology include real-time situational awareness and fire monitoring, burned area mapping/analysis, reconnaissance of rugged/inaccessible terrain, and delivery of geo-tagged imagery to GIS/image analysis experts.

Working with UAS data (imagery) requires a unique skill in order to efficiently produce actionable products. This test is an initial step in determining the training/skill requirements of incident personnel to turn still images and video into useful incident planning/operational products.

Specific UAS objectives and procedures will be documented in the North Fire Incident Action Plan (IAP).

GENERAL LOCATION/DESCRIPTION
(Provide description and attach map—map must include aerial hazards)

IAP map inserted at end of document.

JUSTIFICATION FOR AIRCRAFT USE The Interagency Fire UAS Subcommittee has been tasked by the National Interagency Aviation Committee (NIAC) to develop an interagency strategy for incident UAS operations. Committee goals for 2016 include utilizing fleet aircraft and operators to test UAS on wildfires, collaborating with IMTs to develop operational procedures, developing IQCS UAS positions, and determining how to turn data into actionable intelligence.

On the North Fire, UAS will be utilized to gather information in areas where manned aircraft or ground personnel cannot access safely.

- A micro-UAS will be tested as a crew level situational awareness tool.
- Small UAS (fixed/rotor) will be used to collect video and still imagery for Operations and Planning personnel.
- A final report will be written to address lessons learned, operational procedures, and proposed UAS Operator/Manager roles and responsibilities.

AIRCRAFT INFORMATION		
Cooperator X (BLM) / Agency ☐ / Vendor ☐ / Military /RAIDS ☐ / Other ☐		
Type of Flight: UAS/Aerial photography	Desired Make/Model: Falcon, Hover, 3DR Solo	
Vendor: BLM Owned – Gil Dustin	Phone: 208-387-5181	Cell: 970-210-6153
Aircraft N#: NA	Make & Model: Falcon, Hover, Solo	Aircraft Color: White (Falcon/Hover) Black (Solo)
Pilot Name: Dustin, Eisele, Stroud	Pilot Contact number: See below (participants)	
Pilot Carded: X Yes ☐No Expiration Date: 3/21/17	A/C Carded: X Yes ☐No Expiration Date: 4/18/17	
Type Procurement: Agency owned and operated	Charge Code: P3J9F5	
Estimated Flight Hours: 40	Estimated Cost: There is no AV or FT cost for BLM UAS	

SUPERVISION	
Project Aviation Manager: Gil Dustin	Contact Number: 970-210-6153
Forest/Unit Aviation Officer:	Contact Number:

PARTICIPANTS- list individuals involved in flight(s)	
Name: Gil Dustin	Project Role/Responsibility: Crew Leader/UAS Operator
Name: ~~Bobby Eisele~~ Steve Rumaekers	Project Role/Responsibility: UAS Operator
Name: Steve Stroud	Project Role/Responsibility: UAS Operator
Name:	Project Role/Responsibility:
Name:	Project Role/Responsibility:
Name:	Project Role/Responsibility:

CARGO – Not Applicable						
Weight:	Hazardous Materials	☐ Yes	☒No	Pilot Briefed	☐ Yes	☐No
Weight:	Hazardous Materials	☐ Yes	☒No	Pilot Briefed	☐ Yes	☐No

FLIGHT FOLLOWING – Line of sight required. UAS Crew will notify dispatch/helibase pre and post flight.		
Flight Follow: ☐ AFF ☐ Radio (15 minute check in)	Request or Flight #: ☐ SEE North Fire IAP	
FM Receive:	FM Transmit:	Tones:
FM Receive:	FM Transmit:	Tones:
FM Receive:	FM Transmit:	Tones:
AM Air to Air:	AM Unicom:	Other:

MILITARY TRAINING ROUTE (MTR) or MILITARY OPERATING AREA (MOA) INFORMATION -Aircraft Manager must confirm with dispatch prior to the flight that affected routes' schedules contacted for route activity

MTR/ MOA	Route Legs-Altitude	Activity	Time		Time Zone
VR-1233		☐Hot ☒Cold	Start	Stop	☐UTC ☐Local
VR-176		☐Hot ☒Cold	Start	Stop	☐UTC ☐Local
SR-211		☐Hot ☒Cold	Start	Stop	☐UTC ☐Local
		☐Hot ☐Cold	Start	Stop	☐UTC ☐Local

PERFORMANCE PLANNING

The pilot is responsible for the accurate completion of helicopter load calculations and/or airplane performance planning. For contracted flight operations requiring a government representative, the Helicopter or Flight Manager shall ensure that (1) aircraft performance planning is conducted in accordance with the associated procurement document, (2) that manifests are completed and accurate, and (3) that operational weight and balance calculations are completed. Trained personnel shall ensure that aircraft scheduled are capable of performing the mission(s) safely and within the capabilities of the aircraft selected.

PERSONAL PROTECTIVE EQUIPMENT

Type of Operation – check applicable boxes	**Personnel Protective Equipment Requirements**
☐ Rotor Wing Ground Operations	Fire resistant clothing, hardhat w/chin strap or approved aviator flight helmet, fire resistant and/or leather gloves, all leather boots, eye protection, hearing protection.
☐ Rotor Wing All Flights	Fire resistant clothing, approved aviator flight helmet, fire and/ or leather gloves, all leather boots, hearing protection.
☐ Doors off Flight	Personnel will remain seated and inside fuselage during all flights, approved secondary restraint harness for doors off flights (only for PLDO, HRAP, HRSP, Aerial Photography, IR Operator, ACETA Gunner, Cargo Letdown)

SEARCH AND RESCUE – EMERGENCY RESPONSE

Crash/Search and Rescue Procedures:

- **Contact Dispatch who will initiate the Aviation Incident/Accident Response Plan.** This initiation includes accomplishing all emergency and administrative notifications.
- **On-site emergency response will be handled by the aircraft personnel and other project personnel, and will comply with appropriate guides (examples: Interagency Helicopter Operations Guide (IHOG) or Forest's Aviation Incident/Accident Response Guide.**

SPECIAL CONSIDERATIONS and JUSTIFICATIONS:

(List justifications for deviating from SOP, policy etc.)

All UAS operations will be conducted within DOI, BLM, and USFS policy
An Emergency Certificate of Authorization (ECOA) will be granted by the FAA for this mission.
The UAS will remain in line of sight of operators at all times.
The UAS crew will remain in communication with dispatch, helibase, aircraft, and other key personnel as directed.
UAS crew will coordinate with helibase and assigned aircraft to ensure adequate separation in flight.
UAS will be programmed to return to the launch location in the event of lost command/control link or GPS malfunction.
UAS will have the capability to land immediately.
UAS crew will participate in all aviation briefings on the incident.
All operators and aircraft are authorized for this mission as per DOI policy.

CRASH RESCUE/MEDI-EVAC PLAN – highlighted area is the minimum information regarding medical/emergency response to be filled out prior to review and approval. The remaining fields should be completed as much as practical prior to the day of operation.
General Instructions: Will follow North Fire IAP Medical Plan ICS 206
In the event of an accident, the UAS Crew Leader will supervise and coordinate crash rescue activities. Specific crash rescue duties will be assigned to UAS operations personnel each morning before flights of any kind. Crash rescue and first aid equipment will be located near the UAS operations site and equipment's location made known to all personnel. Information and instructions will be sent/ received through the local dispatch office or communications.
EMT (S) ON PROJECT
Names: Steve Stroud (UAS Crew)
AVAILABLE MEDIVAC HELICOPTERS
FAA # 1MA | HEMG or Contact Springerville Helitack B407
Litter/Rappel/Extraction Capable? Litter capable
Remarks See North Fire Medical Plan ICS 206
FAA # 0VR | HEMG or Contact Sandia Helitack Astar B3
Litter/Rappel/Extraction Capable? Litter capable
Remarks

NEAREST MEDICAL FACILITY	Name/Location Socorro General	
Latitude N34 01.30	Longitude W106 54.20	Contact Freq VHF 154.2950
VOR ONM	Nautical Miles 23	DEG 160
NEAREST BURN CENTER	Name/Location UNMH	
Latitude N35 05.319	Longitude W106 37.068	Contact Freq VHF 154.2950
VOR ONM	Nautical Miles 53	DEG 360
LIFEFLIGHT	Name/Location PHI Air Medical , Socorro	
Type Aircraft	Phone #1-800-633-5438	Contact Freq 154.2950

SPECIFIC INFORMATION AND INSTRUCTIONS (Utilize cell phone if possible. Do not use names over the radio)
1. Nature of the injury(s)/illness
2. Is medical help needed? If available supply vital signs!
3. What transportation is needed? Is patient(s) ambulatory?
4. Location of victim.
5. Route to be taken (use land marks as guide).
6. Equipment needed.
7. Name of contact on site.
8. Notify appropriate agency line officer.
SITE CONDITIONS

Latitude:	Longitude:	Contact Freq:
Wind Speed:	Elevation (msl):	Temperature:
Terrain Factors:	Helispot Minimum Size:	
Proximity of Helispot to Injury Site :	Visibility/Sunrise/Sunset Limitations:	
Flight Hazards:		
Other Aircraft in Area (Call Signs & Freq.): H181MA (B407) assigned to North Fire		
Ground Contact & Frequencies:		

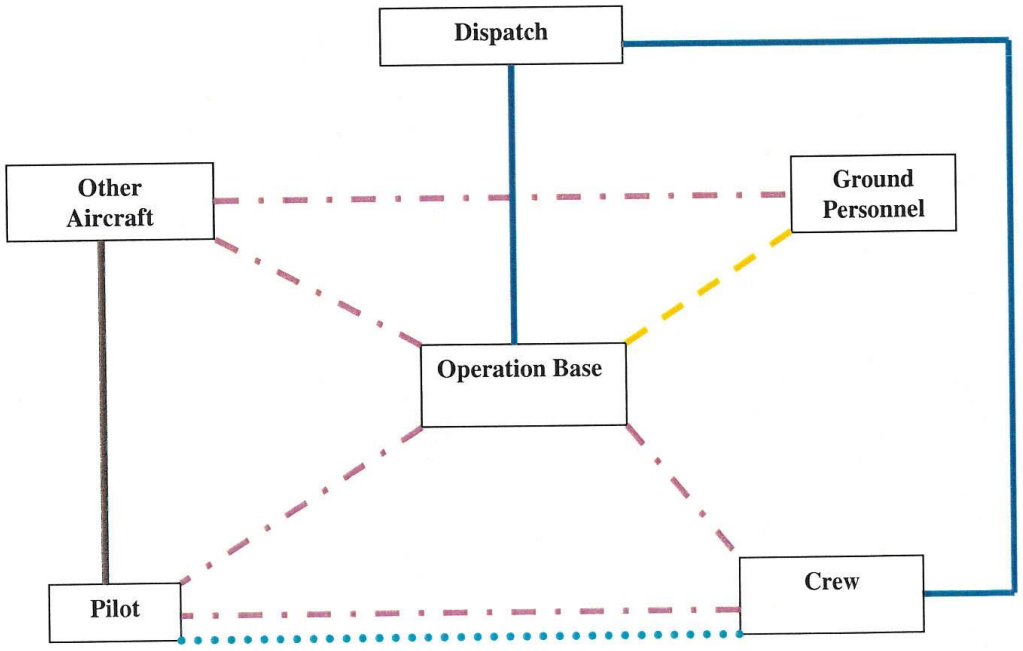
COMMUNICATIONS PLAN (North Fire ICS 205)

Legend

Command
Air to Ground
Tactical
Flight Following
Air to Air

Frequency List:

Name	RX	TX	Tone
Command 1	170.525	170.525	123.0 (BS)
Command 2	170.525	172.350	167.9 (TX)
Tac 1 (Div A)	167.550	167.550	
Tac 2 (Div B)	168.675	168.675	
A/G	168.4875	168.4875	
Deck	163.100	163.100	



AVIATION RISK ASSESSMENT WORKSHEET
Assess the risks involved with the proposed operation. Use additional sheets if necessary. Line Officer/Designee Signature Required. Reference Risk Management Workbook

Risk Assessment Matrix

	Severity			
Likelihood	Negligible IV	Marginal III	Critical II	Catastrophic I
Frequent A				
Probable B				*HIGH 4*
Occasional C			*Serious 3*	
Remote D		*Medium 2*		
Improbable E	*LOW 1*			

Appropriate Management Level for Risk Decisions		
Risk Level	**Fire**	**Project**
High	Incident Commander or Operations Sections Chief	Line Officer/Manager
Serious	Incident Commander or Operations Sections Chief	Line Officer/Manager
Medium	Air Operations Branch Director	Project Aviation Manager
Low	Base Manager	Helicopter or Flight Manager

Severity Scale Definitions	
Catastrophic	Results in fatalities and/or loss of the system.
Critical	Severe injury and/or major system damage.
Marginal	Minor injury and/or minor system damage.
Negligible	Less than minor injury and/or less than minor system damage.

Likelihood Scale Definitions		
Frequent	Individual Fleet	Likely to occur often. Continuously experienced.
Probable	Individual Fleet	Will occur several times. Will occur often.
Occasional	Individual Fleet	Likely to occur sometime. Will occur several times.
Remote	Individual Fleet	Unlikely to occur, but possible. Unlikely but can reasonably be expected to occur.
Improbable	Individual Fleet	So unlikely, it can be assumed it will not occur. Unlikely to occur, but possible.

Assess the risks involved with the proposed operation. Use additional sheets if necessary.			
	Pre-Mitigation hazards rate out as:		
Describe the Hazard:	Likelihood A-E	Severity I-IV	Risk Level
1. Mid-air collision with another aircraft	D	I	3
2. Collision with personnel	C	II	3
3. Collision with vehicles	B	I	4
4. Operating A/C outside of approved area	B	II	3
5. Operating aircraft outside of manual limitations	B	II	3
6. Fire	D	II	2
7. Cold Injury	C	II	3
8. Loss of Link with aircraft. (LOL)	C	II	3
9. Injury to fingers/hands due to spinning blades on aircraft	C	II	3
10. Hazardous wildlife (snakes, spiders) may be present	C	III	2
11. Cutting hand when starting aircraft	C	III	2
12. Reduced visibility when driving on dirt roads	A	III	3
13. Operating in a new location leading to conflicts with manned aircraft	B	I	4
14. Collision with a fixed aerial hazard.	D	IV	1
15. Night Operations and Travel	A	II	4
16. Intrusion of news or LE aircraft	C	II	3
Pre-Mitigation Overall Rating:			3 High

Mitigations:	Post Mitigation hazards rate out as:		
	Likelihood A-E	Severity I-IV	Risk Level
1. NOTAM will be filed and local law enforcement and news organizations with helicopters will be notified in advance of the flights. Aircraft separation will be maintained through communication with helibase and incident aircraft. UAS crew will monitor assigned air to air and air to ground frequencies.	E	I	2
2. Flight patterns will be planned so to avoid people on the ground when approaching for landings. Non-participating personnel will remain clear of the ground control station so as not to be a distraction to the operators. Landing areas will be established that minimize risk of impact to people. Overflight of personnel will be avoided. Observers will be kept at a safe distance from the launch/recovery area and out of the flight path of the aircraft.	D	II	2
3. Vehicles will be parked clear of approach and departure routes. Overflight of vehicles will be avoided.	E	IV	1
4. UAS will be programmed to stay within the operating areas in the event of LOL. Boundaries will be briefed and maps will be uploaded into the operator control units if they have the capability. FAA airspace authorization will be in place for the duration of mission.	D	IV	1
5. All operations will stay within the manual limitations for the aircraft.	C	IV	1
6. IC will be immediately notified of any fire. They have on-site firefighting elements and will hand extinguishing any fires.	E	II	1

8. Prior to launching any aircraft the LOL settings will be verified. LOL setting will be to have the aircraft return to its point of launch and AUTOLAND. If LOL happens for more than 3 minutes FAA will be notified with the last location and heading of the UAV.	C	IV	1
9. Checklist procedures will be followed to ensure that personnel ensure that their hands stay clear of rotating blades.	D	II	2
10. Personnel will be briefed on the hazard and advised to look where they are going and be aware of their surroundings.	D	III	1
11. Personnel will be provided with appropriate protocol for starting aircraft.	D	IV	1
12. Maintain wide spacing between vehicles.	A	IV	2
13. Prior to operating in any new area coordination will be done with the appropriate approving authority and airspace will be deconflicted through the appropriate method. No sUAS will be launched until approved by the controlling authority.	D	I	3
14. Prior to operating the Aerial Hazards Map will be reviewed by everyone.	E	IV	1
15. Pilots will be rested in appropriate facilities. Driving safety will be briefed to all involved. AAR will be conducted and fatigue issues will be addressed as part of the debriefing.	D	II	2
16. Public notice will go out on the first day. The IMT will coordinate with any applicable LE units/news stations that may have aircraft and ensure they are aware of the UAS missions.	E	I	2
Post-Mitigation Overall Rating:			2 Med.

Success Probability/Benefits Statement:
A high margin of safety is expected. Overall risk will be reduced to an acceptable level by the use of various controls to ensure safety of flight and personnel. Coordination between the requesting unit, dispatch, and IMT personnel will occur in order to minimize risk.

Daily UAS Safety Briefing

Briefing Leader: _____

Briefing Date:_____Time:_____Location: _____

Discussion Items:

___A. Hazard Analysis (as outlined in plan)

___B. Safety Air Ops (Ground)

___C. Safety Air Ops (Flight)

___D. Military Training Routes/Restricted Airspace Deconflicted

___E. Flight Following

___F. Frequencies

___G. Lost Link Procedures

___H. Emergency Evacuation Plan

___I. Authorities

___J. Weather Considerations

___K. Review applicable JHAs/Risk Assessments

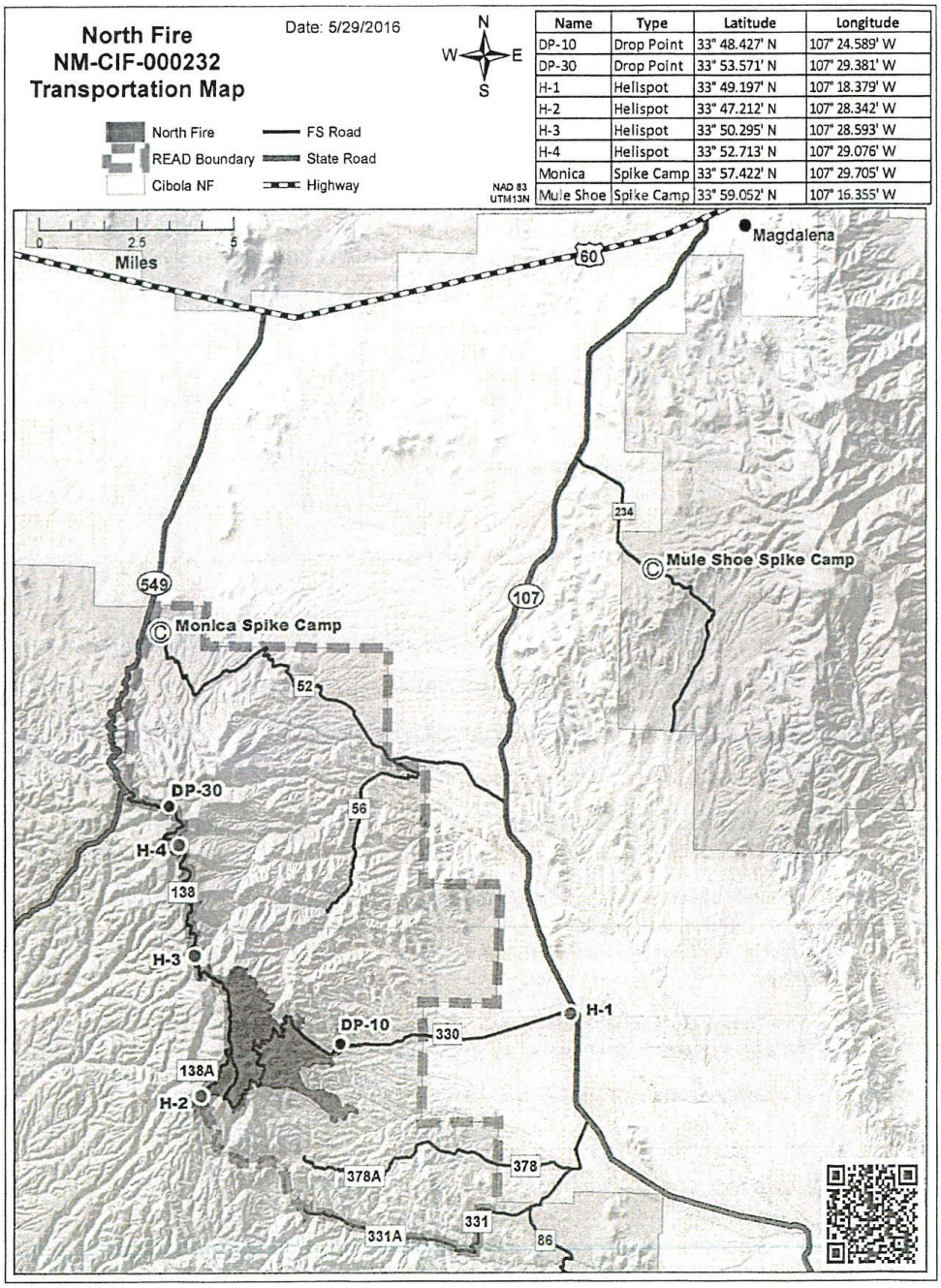
___L. NOTAM on file

___M. Other

Attendees:

Daily UAS Mission Checklist			
A. Chain of command, individual roles and responsibilities are identified to all participants?	Yes	No	NA
B. Project Aviation Safety Plan is approved and signed at the appropriate levels?	Yes	No	NA
C. Is the emergency evacuation plan reviewed?	Yes	No	NA
D. Are all elements in place to track the UAV at all times?	Yes	No	NA
E. Can terrain, altitude, temperature or weather that could have an adverse effect be mitigated?	Yes	No	NA
F. Are all aerial hazards identified and known to all participants?	Yes	No	NA
G. Have ground operations hazards and safety been identified to all participants?	Yes	No	NA
H. Have mitigating measures been taken to avoid conflicts with military or civilian aircraft?	Yes	No	NA
I. Have adequate landing areas been identified and or improved to minimum	Yes	No	NA
J. Are all agency personnel qualified for the mission?	Yes	No	NA
K. Are there enough (qualified) agency personnel to accomplish the mission safely?	Yes	No	NA
L. Is the pilot carded and experienced for the mission to be conducted?	Yes	No	NA
M. Will adequate briefings be conducted prior to flight with all participants?	Yes	No	NA
N. Is the aircraft capable of performing the mission with a margin of safety?	Yes	No	NA
O. Does the aircraft have the capability to perform the mission based on predicted weather conditions?	Yes	No	NA
P. Is the aircraft properly carded?	Yes	No	NA
Q. Do all personnel have the required PPE?	Yes	No	NA
R. Remember; maps of areas/sites, handheld radios, cell phones.	Yes	No	NA
S. Are pilot flight and duty times compromised?	Yes	No	NA
T. Is there an alternative method that would accomplish the mission more safely?	Yes	No	NA
U. Have the proper approvals been given by FAA?	Yes	No	NA
V. If flying in Restricted Airspace, has notification been made with controlling authority prior to launching sUAS?	Yes	No	NA
W. Other? (identify) NOTAM on File	Yes	No	NA
X. Other? (identify) Aerial Hazard Map reviewed	Yes	No	NA
Y. Other? (identify) Olympic Dispatch notified of flights	Yes	No	NA
Identify Corrections (if any):			

UAS Team Leader Signature:		**Date:**	


North Fire
NM-CIF-000232
Transportation Map
Date: 5/29/2016
N
W
E
S
North Fire
READ Boundary
Cibola NF
FS Road
State Road
Highway
NAD 83
UTM13N
Name | Type | Latitude | Longitude
DP-10 | Drop Point | 33° 48.427' N | 107° 24.589' W
DP-30 | Drop Point | 33° 53.571' N | 107° 29.381' W
H-1 | Helispot | 33° 49.197' N | 107° 18.379' W
H-2 | Helispot | 33° 47.212' N | 107° 28.342' W
H-3 | Helispot | 33° 50.295' N | 107° 28.593' W
H-4 | Helispot | 33° 52.713' N | 107° 29.076' W
Monica | Spike Camp | 33° 57.422' N | 107° 29.705' W
Mule Shoe | Spike Camp | 33° 59.052' N | 107° 16.355' W
0
2.5
5
Miles
Magdalena
60
234
Mule Shoe Spike Camp
549
107
Monica Spike Camp
52
DP-30
56
H-4
138
H-3
H-1
DP-10
330
138A
H-2
378A
378
331
331A
86

North Fire UAS project proposal form

U.S. Forest Service Unmanned Aircraft System (UAS) Project Proposal

This form documents essential information to be considered for review and approval of planned UAS missions conducted and/or contracted by the Forest Service. *Note: A completed project aviation safety plan (PASP) and risk assessment are required to accompany this form.*

Administrative Information

Requestor Name:	B. Rogers Warren Cibola Santa Fe Zone UAO (acting)
Title:	North Fire NM-CIF
District/Forest/Region or Research Station:	Southwestern Region, Cibola National Forest, Magdalena R.D.
Email:	brwarren@fs.fed.us
Phone number(s):	
Forest Aviation Officer Name:	Rogers Warren
Forest Supervisor Name or Research Station Director Name:	Elaine Kohrman
Regional Aviation Officer Name:	Kris Damsgaard

Initial Mission Information

	Yes	No
Will the mission be flown within 5 nautical miles of an airport?		X
Will the mission be flown over an urban or relatively dense populated area?		X
Will a manned aircraft be flown at the same time as the UAS as part of this mission?		X
Will the mission be flown beyond the line of sight (BVLOS) of the UAS operator?		X
Does the UAS weigh more than 55 lbs.?		X

If the answer to any of the above is "yes", then a manned aircraft will be required to conduct this mission. Please coordinate with your Regional Aviation Officer.

Project Area Information

Note: Other relevant technical information regarding the project and mission will be documented in the PASP.

Project Location: (i.e. Horse Creek drainage, Jackson District, Smoky National Forest) North Fire, San Mateo Mountains,Magdalena R.D. Cibola NF
Identify Military Training Routes (MTRs) and Military Operational Areas (MOAs) within 5 miles of the project area (include route numbers). VR-1233, VR-176, SR-211

Will the mission take place in or near a Wilderness Area or other type of Special Designated Area (SDA)? A portion of the fire borders the Withington Wilderness Area.
Project Description:- Small UAS (Falcon, Falcon Hover, and 3DR Solo) will be used to gather aerial images and video to support the operational/monitoring objectives of the North Fire. These aircraft are owned and operated by the BLM National Aviation Office.

Sensor Requirements

	Yes	No	Comments (fixed or gimbal mounted, nadir or off-nadir imagery, near real-time availability requirements, etc.)
Electro-optical (EO)/Infrared (IR) Video	X		Gimbal mounted camera on Falcon and Hover. Gimbal mounted GoPro H4 on Solo.
Visible/RGB Camera (visible)	X		Fixed mapping payload (Ricoh GR1) on Falcon and Hover. Gimbal mounted on Solo (GoPro H4).
Multispectral Camera (visible and near infrared)			
Hyperspectral Camera (visible, near infrared and shortwave infrared)			
Thermal Infrared Camera			
Lidar			
Synthetic Aperture Radar			
Meteorology Sensors (temperature, humidity, barometric pressure, wind)			
Chemical/Air Quality Sensors (CO, CO2, O3, NO2, VOCs, etc.)			
Other			

Records Management

Imagery/data collected using UAS and derived products are legally considered agency records. Please specify the planned method to be used to retain these records:
Any digital information will be given to the situation unit on a hard drive for storage with the fire
documentation package.

Signatures and Concurrence

\s\ B. Rogers Warren _____ **5/31/16**

Signature of Preparer Date

Emergency Certificate of Authorization (eCOA)

U.S. Department
of Transportation
Federal Aviation
Administration

Date: June 2, 2016

To: **Brad Koeckeritz**

ADDENDUM TO CERTIFICATE OF WAIVER OR AUTHORIZATION (2016-WSA-28-DOI)

DATES OF USE: This addendum is valid 0500L-2200L, 06/06-19/2016.

PROCEDURES:

This procedure supplements all provisions contained in the primary COA 2016-WSA-28-DOI. The United States Department of Interior is authorized to operate a Falcon, Hover, 3dr Solo, in the vicinity Socorro, NM, within the North Fire TFR, under the control of Albuquerque ARTCC within the following area:

5 NM radius around 344859N/1072647W (ABQ234033.9) at/below 700' AGL

Flights are supporting firefighting activities and will be conducted in Class G Airspace in Visual Meteorological Conditions (VMC) as depicted in the operational area Attachment 1.

1. Amend Page 7-8 of 2016-WSA-28-DOI: **STANDARD PROVISIONS.**
   G. Notice to Airmen (NOTAM).
   Replace (para #1) with:

   File a NOTAM for flights and flight areas, by contacting the Lockheed Martin Flight Service Station NOTAM Office at 1-877-4-USNTMS (1-877-487-6867) as soon as practical, but before the first flight.

2. Amend Page 12-13 of 2016-WSA-28-DOI: **AIR TRAFFIC CONTROL SPECIAL PROVISIONS.**

   A. Coordination Requirements.
   Replace existing verbiage with:

   1. *The operator must coordinate NOTAM information, with Albuquerque ARTCC at (505)856-4500, as soon as practical prior to the start of UAS operations.*
   2. *The operator must notify Albuquerque ARTCC upon completion of UAS activity.*
   3. *In the event ATC needs to communicate with the Department of Interior, the onsite crew member number is: Gil Dustin, 970-210-6153*

B. Communication Requirements:
Replace existing verbiage with:

1. *Direct, two-way communication with Albuquerque ARTCC is not required.*

C. Lost Link/Emergency procedures:
Replace existing verbiage with:

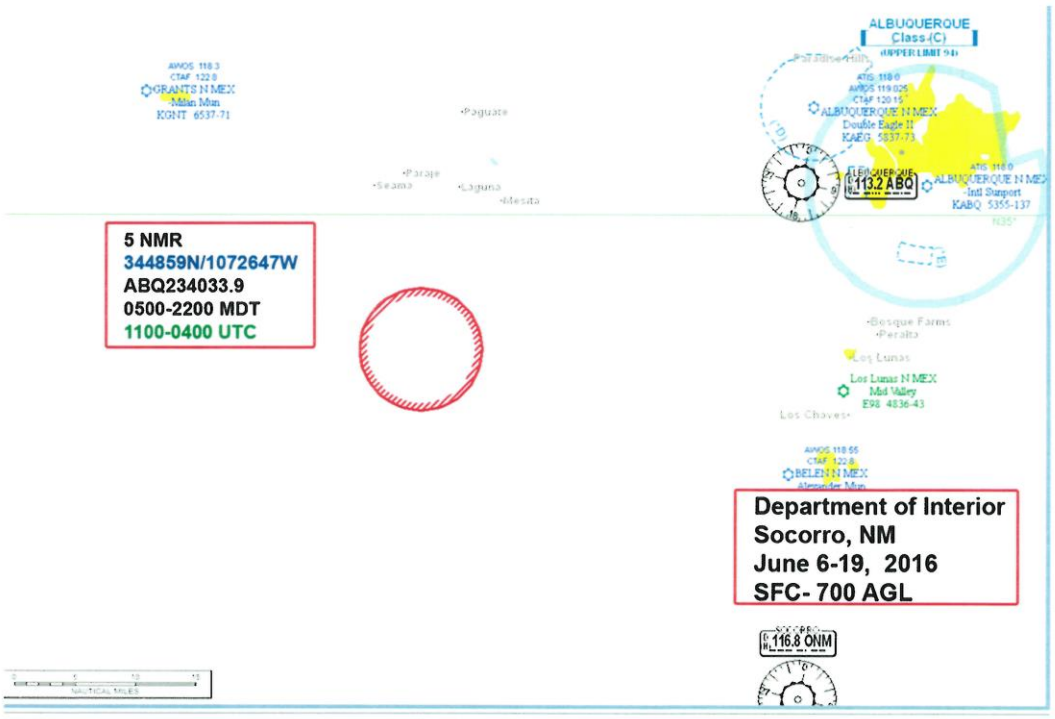
1. *In the event of a lost link, the operator will contact Albuquerque ARTCC at (505)856-4500 and will advise ATC of the nature of the event/emergency and state pilot intentions.*

2. *The aircraft will remain and/or land within the assigned flight area.*

D. Operations Area (See Attachment1)

Operations are to remain within ***5 NM radius around 344859N/1072647W (ABQ234033.9) at/below 700' AGL***

for Franklin D Hatfield
Director, System Operations Security


ALBUQUERQUE
Class C
GRANTS N MEX
Milan Mun
KGNT 6537-71
ALBUQUERQUE N MEX
Double Eagle II
KAEG 5837-73
113.2 ABQ
ALBUQUERQUE N MEX
Intl Sunport
KABQ 5355-137
Los Lunas N MEX
Mid Valley
E98 4836-43
BELEN N MEX
5 NMR
344859N/1072647W
ABQ234033.9
0500-2200 MDT
1100-0400 UTC
Department of Interior
Socorro, NM
June 6-19, 2016
SFC- 700 AGL
116.8 ONM

Cibola N.F. UAS In-Brief

(Based on Current Aircrew Briefing Packet)

- Local conditions, Forest Layout, current fires/incidents, other air resources, local hazards and fire weather.
- Explain Forest/Zone aviation resource location and availability.
- Dispatch office location, phone #'s. Explain Forest maps, layout of Districts, and other cooperating agencies.
- Communications, flight following, and dispatch procedures.
- Flight Hazards Map
- Special use airspace; MOA, Flight Routes, and Restricted Areas - discussed over the Sectional.
- North Fire Airspace Deconfliction procedures for VR-1233, VR-176, SR-211
- Forest Frequencies; air-ground, IA victor, admin, fire, and repeaters. Give frequency lists and repeater map.
- Wilderness Flight/Landing policy – proximity to Withington Wilderness Area
- UAS Specifics
    - Review PASP
    - Review BLM UAS Plan and ECOA
    - Flight Follow local?
    - UAS pilot radio communication with dispatch
    - UAS pilot monitoring Air to Air frequency
    - Public Affairs and NIFC photographer IMT PIO handler?
    - Post incident assignment follow up and AAR

- Local Concerns
    - Integration into IMT (Ops? Plans? helibase? ICS-220)
    - Impact to local unit and T3 IMT
    - Clearly defined outcome (product? service?)
    - Measuring success? And to whom? BLM? WO? RO? Incident?
    - North Fire UAS Operational Risk Management (anything besides PASP RA? DORA, GAR, Mission briefing?)

North Fire UAS tentative timeline

Thursday June 2, 2016

- Finalize Resource orders in ROSS.

Friday June 3, 2016

- BLM Pilots day off for work/rest re-set.

Saturday June 4, 2016

- BLM UAS Module depart Boise.

Sunday June 5, 2016

- BLM UAS Module arrive Albuquerque.
- In-brief with Cibola Forest FAO and Dispatch

Monday June 6, 2016

- In-brief with North Fire IMT and local unit
- Finalize UAS equipment and product needs from North Fire.
- North Fire UAS Mission planning

Tuesday June 7, 2016

- Implement UAS plan

North Fire UAS Assignment Lessons Learned

Overview and Lessons Learned – June 15, 2016

Overview – USFS and BLM collaborated to mobilize a four-person UAS crew to the North Fire on the Cibola National Forrest on June 1, 2016.

The objective of the assignment was to test UAS and UAS sensors in the incident (wildfire) environment and develop operational procedures for future missions based on lessons learned and practical applications of the aircraft/sensors based on feedback provided by operations/planning personnel.

The lessons learned from this assignment will be shared with the interagency community and the Interagency Fire UAS Subcommittee (IFUAS) as an initial step in developing a strategy to safely and effectively integrate UAS into incident operations.

Crew Composition
Gil Dustin, UAS Crew Leader, UAS Operator (BLM)
Steve Stroud, UAS Operator (BLM)
Steve Ramaekers, UAS Operator (DOI/OAS)
Jeff Safran, Data Specialist (BLM)

UAS Aircraft
Falcon (fixed wing) sUAS
3DR Solo (quad copter) micro UAS

Sensors
Falcon - 2 axis stabilized gimbal video payload (Sony Block and Tao 2 640 IR)
Falcon - Sony A-5100 with Voightlander lens (mapping/photogrammetry)
Solo - Gimbaled GoPro Hero 4 (mapping/video)

Flight Times
Falcon – 2 missions for 56 minutes
Solo – 23 missions for 5.73 hours

Operations Summary
UAS were flown in two Divisions on the incident and provided live infrared video, performed mapping missions, and provided real-time intelligence and situational awareness to firefighters. Data (still and video imagery) was collected and sent to a processing specialist every evening over a Wi-Fi network.

Data Processing Summary

Each evening the flight crew uploaded that day's imagery, video and telemetry logs to a shared drive that the UAS Data specialist could download the data from. Any data in the form of video files was multiplexed using the ArcGIS Full Motion Video AddIn for ArcGIS 10.4. The flight path and video framed could then be placed on a map for spatial awareness.

Any aerial photography datasets were processes using Agisoft Photoscan, and resulting Ortho mosaics and Digital Elevation Models (DEMs) were delivered back to the shared drive, along with a map of the products. The maps were generated as GeoPDF for use on tablets and phones.

Assignment Chronology

6/5 Crew mobilizes from Boise, ID with Govt. vehicle.

6/7 Crew receives briefing from USFS UAS Program Manager, Jami Anzalone and the local dispatch/aviation staff and provides demonstration of aircraft at Cibola Forest Headquarters. Crew meets with SWICC staff to discuss operations. Crew checks in at the incident and develops an operational plan with the Operations Chief.

6/8 Crew provides and aircraft demonstration to fireline personnel in Division B.

6/9 Crew performs Infrared mission to support burnout operation in Division B
Crew attempts to provide an aircraft demonstration in Division A, but scrubs the mission due to thunderstorm activity.

6/10 Crew flies a mapping mission in Division B (Cooney Gap)

6/11 Crew works in Division A and demonstrates the capability of the micro system to provide real-time situational awareness and intelligence gathering.

6/12 Crew flies mapping mission in Division A (Big Rosa canyon area).

6/13 Crew attempted flights to support a burnout in Division A. The burnout and flights were postponed due to high winds.

6/14 Crew works on the fireline with Division A and Kings Peak Fire Wildfire Module and provides real-time intelligence to ignition/holding crews.
Crew demobilizes from the incident.

What Worked Well

- Resource orders were processed efficiently once the crew was statused in ROSS as THSP.
- The PASP was written and approved within 24 hours.
- Coordination between agency Public Information Officers.
- Treating the UAS/Crew as a normal aviation asset and including them in operational briefings.
- Working with helicopter pilots and OSC3 to establish aircraft separation procedures and mission priorities.

- Direct communication with the helicopter to coordinate missions in the same geographic area (Fire Traffic Area protocol).
- Integrating into the traditional ICS structure via the Planning and Operations Section Chiefs.
- **Working directly with crews to demonstrate and provide situational awareness. Firefighters would watch live video on a tablet (IOS device) as the aircraft flew over points of interest as directed.**
- Developing high resolution mapping products for pre and post burn analysis.
- Having a Data Specialist work a night shift to develop planning products (maps).
- Using established technologies to view map products. Most of the firefighters carried IOS devices to view geo-referenced maps with the Avenza app.
- Flight crew coordination with the Data Specialist, primarily by texting and evening phone conversation.
- Aerial photography flights with GeoTagged photos were easy to process.
- The ESRI Full Motion Video (FMV) extension worked as designed, and allowed the video to be displayed spatially.
- The shift offset between the Data Specialist and flight crew was good. The UAS Data Specialist is a cross between a GISS and an IRIN, working afternoons into the night.

Challenges

- Incidents don't typically require a PASP. Building a PASP for fire use is inefficient.
- Familiarizing IMT personnel with the capabilities and limitations of the aircraft.
- Familiarizing IMT personnel with final data product types.
- Uploading data over a WiFi network.
- Finding safe launch and recovery areas for the fixed wing system.
- Lack of aerial supervision caused delays for some UAS flights. Our protocol for this assignment was to obtain flight clearance from the OSC who was extremely busy coordinating incident operations.
- The ground control station monitors were extremely difficult to see in direct sunlight.
- Hand flying the micro UAS for situational awareness. A high degree of skill is required.
- DOD GPS testing caused two flight delays.
- FAA Emergency Certificate of Authorization (ECOA) process was not implemented as advertised. There was confusion between Albuquerque ARTCC and the ECOA office, which created a substantial workload for the DOI staff.
- Current work/rest policy for UAS flight crews was difficult to manage and may not be appropriate since most of the crew's time was spent performing normal and expected incident duties (driving, briefings, hiking, etc.).
- Data Management was the single biggest time hit for the Data Specialist. It was very time consuming to match up the logs with videos, especially having not been on site.
- Data transfer rates between the BLM NOC EGIS servers over VPN was very slow.

Items to Work on

- Design a standard UAS ordering process.
- Mobilization times. Consider shipping equipment to the incident and flying the crew to it.
- Establishing a high trust climate between UAS and assigned flight crews.through face-to-face communication prior to mission implementation.
- Developing UAS briefing products for end users.
- Establishing NWCG training and positions for incident UAS personnel.
- Increasing the efficiency of data sharing processes.
- Developing terrain following features for UAS flight planning.
- Developing altitude limit failsafe's future micro UAS flights.
- Shared folder location on the NIFC FTP server, similar to GIS and IR would be very helpful for data transfers.
- We need to define what the final geospatial products are so that the data specialist knows exactly what to put together. Even having some MXD templates would be very helpful.
- The ESRI FMV software needs to be on the BLM Software baseline for ArcGIS 10.4 so other people can view the videos with their spatial components. Alternatively we could put this software on Fire laptops
- UAS Data Specialist should have a Fire Laptop for data processing.
- DOI and FAA must be lockstep in the ECOA process.

Applying Lessons Learned – Action Items

- Develop an *Interagency UAS Operations Guide*, which captures all the requirements of a PASP. This will mitigate the need to write a PASP for every incident response.
- Build a UAS briefing packet for incident use.
- Research SATCOM for data upload, download, and live video feeds to incident decision makers.
- Conduct debriefs focusing on data and products, particularly on the final deliverables.
- Training for the GISS personnel on what data we can provide.
- Work with UAS vendors and ESRI on simplifying the data processing workflows.

Kudos

- Thanks to Jami Anzalone for her work coordinating this assignment with the Forest, IMT, and Public Information Officers.
- The Command and General Staff were accommodating and receptive to testing this technology.
- The Division Supervisors (Chris Brashears and Ben Sanders) were easy to work with and excited to develop uses for UAS on the fireline.
- The Kings Peak Wildfire Module was receptive to testing this technology to provide situational awareness, scout line, and monitor fire activity.
- The Albuquerque Dispatch staff was easy to work with for flight planning and resource tracking.

- Brad Koeckeritz and Colin Milone at DOI/OAS did a great job coordinating with the COA Office.
- FAA did a great job efficiently managing the confusion regarding the ECOA process and authorizing flight on this incident.
- The Forest Supervisor, Rogers Warren, Riva Duncan and management staff did a great job authorizing this assignment and approving mission-planning documents.

Conclusions

- Micro UAS are a powerful tool on the fireline. The crew we worked with (Kings Peak) found immediate utility. UAS program strategies must be developed to safely integrate this technology into established fire/aviation incident management/operations procedures.
- UAS capable of 16-24 hr. flights, loitering above all incident aircraft, and delivering high resolution images/video in multiple spectrums will be more effective than flying smaller systems to gather imagery to develop planning products.
- Micro UAS used for crew level situational awareness and large UAS used for strategic planning may be a consideration for UAS program development within incident management.
- It's critical to maintain an interagency approach regarding UAS operational procedures, qualifications, and data support/management.
- National UAS procedures and guidelines will ensure a safe approach to incident UAS operations.

Submitted by:
Jeff Safran
Steve Ramaekers
Steve Stroud
Gil Dustin